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18 July 2007

ORIGINAL

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: ***Ex Parte Comments in MM Docket No. 93-177 pertaining to AM Directional Antenna Performance Verification Coalition Presentation dated May 4, 2007***

Dear Ms. Dortch:

Potomac Instruments, inc. (**PI**) is a manufacturer of Antenna Monitors and Field Strength Meters designed to monitor certain operating performance parameters of Medium Wave directional antenna arrays. The company has supplied these devices, worldwide, to broadcast licensees and regulatory agencies, alike, for many decades. As such, through continuous dialog with operators, consulting engineers, and regulators we have amassed a collective knowledge base regarding the day to day functioning and environmental challenges that confront the operators of simple two tower DA-1 arrays, complex 13 tower DA-3 arrays, and various combinations and permutations of multi-tower arrays in-between. Accordingly, we feel compelled to offer our voice to the conversation initiated by the above referenced presentation and accompanying "Rule" change proposals. Lest the reader assume that we are motivated solely by commercial self interest in this matter, we would like to point out that **PI** has been a supporter of Method of Moments (MoM) array modeling and has been a consensus member and co-signer of preceding ad hoc initiatives advocating the use thereof.

PI commends the AM Directional Antenna Performance Verification Coalition (Coalition) for its work, diligence, and enthusiasm while advancing collective support for an enhanced role for computer modeling technology in the licensing and regulation of AM Directional Antenna Arrays in the 21st century. We concur with the Coalition that MoM modeling, in the hands of a competent engineer, is a very powerful and useful tool for setting up the phasing elements for a given medium wave directional antenna array. We believe that the "measure what you model and model what you measure" maxim, if diligently followed, will enable said individual to accurately determine the pattern of the radiated energy as it originates from the antenna site. We do sincerely question, however, the leap of faith which is implicit in the petition and suggests that this new tool is so powerful that, if universally applied, its use would preclude any further need for field strength monitor points in the U.S. AM Broadcast domain.

It is generally accepted that almost all verifiable scientific and engineering projects involving conclusions derived from models and calculations can be supported by experimental evidence and should be accompanied by supporting measurement data that can be confirmed by third parties conducting the same experiments independently. The Coalition proposal does provide specific procedures for establishing modeling impedances and sampling line characteristics for each element in the antenna array that would, presumably, be recorded in the commissioning engineer's report that is submitted to the Commission. Such measurements *could conceivably be* independently confirmed. A reasonable person must question how realistic it is to assume that an FCC inspector or other independent third party could, at will, gain access to a given transmitter facility, set up test equipment, turn the transmitter off, disconnect the feed lines at the output of the ATU and sampling lines and then attempt to duplicate the measurements that were used for modeling purposes.

In MM Docket 93-177 the Notice of Inquiry (NOI), dated 29 June 1993, the commission states in part:
"The purpose of these rules is to set out the Commission's regulatory framework for assuring that AM directional arrays will be properly designed, constructed, tested, *monitored and maintained* (emphasis added). This is necessary because a misadjusted array could cause interference to cochannel and adjacent channel stations both locally, via groundwave signals, and at great distances, via skywave signals. Misadjustment of an array can arise from many causes, including faulty measurement equipment and faulty measurement procedures. It is often difficult to reconcile theoretical calculations of array performance with actual field measurements of an array's performance. Several sophisticated antenna array modeling programs are now available for use on computers which can predict patterns for very complex combinations of power and phase. It is difficult with these programs, however, to take into account the collateral effects of obstructions, such as buildings and nonresonant wires (e.g. power and telephone lines), which are proximate to the array being analyzed."

We remind the reader that, when this NOI was written (June 1993), AM Directional licensees in the US were required to read and record parameters from base current meters, antenna monitors, and field strengths at specified monitor points. Like the proverbial three legged stool, the data derived from these three cross checking indicators provided confidence in the stability of the antenna pattern and each individual measuring device, in turn, could be removed from service for factory repair and or calibration without jeopardizing the station's ability to confirm their legal operation. Through subsequent Rule changes, requirements for base current meters have been eliminated, field strength reading requirements have been greatly reduced and antenna monitor reading and logging requirements have been virtually eliminated. If the Coalition's suggested Rule changes are adopted, as submitted, the only required "baseline" indicator would be a rarely read, un-logged, and possibly uncalibrated antenna monitor.

We are conversant with the arguments that portray field strength readings as scalar in nature, inherently inaccurate and, therefore, useless for purposes of measuring the antenna array parameters that they purport to measure. We do not quibble with the anecdotal data that is presented in support of those arguments for altering FCC Rules that stipulate that these measurements are the sole means for "proofing" an antenna array. (We do note with interest that proponents of computer modeled arrays usually present documents showing measured field

strength and modeled field strength as plotted against corresponding FCC Standard Patterns as evidence of the effectiveness MoM modeling.) Again, what we challenge is the corollary conclusion that these field strength meters are, some how, unacceptable as array monitoring devices. This type of reasoning would imply that the directional antenna arrays commissioned prior to the advent of computer modeling were all based upon unsound data. We do not believe this is to be the case. Any empiricist knows that repeatability is the hallmark of scientific measurements. The concept of ratiometrics is as old as the balance scale. It tells us that if a given measurement can be repeated, over time, parameter stability can be assumed and limited absolute measurement uncertainties can be disregarded. Using technology that is now forty years old, we know that two, properly calibrated, **PI** FIM-41 Field Strength Meters will track each other over their frequency range, dynamic range, time, and temperature to within ±0.5 dB. We believe that this tolerance is quite adequate for array monitoring purposes.

The petitioners gratuitously dismiss field strength readings as a means for analyzing antenna system performance in antenna proofs as "fundamentally flawed, particularly in urban areas and other realistic environments where field strength measurements are especially unreliable". From that premise, they weave a scenario of proposed rules which eliminate the requirement for field strength measurements entirely, provided the antenna array was licensed on the basis of computer modeled data. **PI** submits to the reader that field strength measurements, taken by competent technicians using properly designed instruments, are repeatable absent readily identifiable changes in the physical environment of the antenna array. Accordingly, such measurements are quite suitable for the purpose of detecting changes in radio frequency energy levels at various locations should change occur. Field strength readings are of significant value to the licensee, to the erectors of potential re-radiators, and to Commission Field Engineers provided designated monitor points have been established and historical data exists.

Monitor point data also provides a means of measurement system redundancy and independent third party verification. It seems neither onerous, nor inappropriate to require a modeling engineer to establish specific field strength monitor points and to document the field strength values that are present, as physically measured, at these designated points on the date the array was modeled. Should monitor point values change over time because of "proximity effects, scattering, seasonal changes in ground conductivity, and land development along propagation paths" these changes can, and should be, documented and explained in station maintenance logs leaving a clear, precise, and permanent record of periodic data thus building a baseline of information in the event that such information is needed in the future. Routine monitoring of RF levels at designated points for a medium frequency directional antenna array is simply good engineering practice.

Except for the explicit purpose of virtually eliminating regulatory oversight, we can think of no reason why it would it not be in the best interest of the broadcast industry to create a regulatory system that marries the technologies of computer modeling and repeatable field strength monitor points in a meaningful Computer Modeled Antenna Performance Verification licensing process. We believe that the reasoning used by the Commission in its Docket 93-177 Report and Order (RO) which was released in March 2001 was valid then and remains valid today. That RO significantly reduced the required number of measurements for radials in measured proofs but retained the requirements for monitoring points because "they provide the

only indication of directional antenna performance outside the station's transmission facilities." We can think of no reason why established criteria for monitor point designation or modification under measured performance rules would not be appropriate for computer modeled performance rules.

We fully expect that responders to these comments will regale the Commission with anecdotal tales of the "wandering" monitor point. We are aware of monitor point data in Nebraska that varies with the growth stages of the local corn crop and others that vary with moisture content of surrounding wetlands. We recognize that antenna pattern distortions can and do accompany projects associated with local land development. We also know that, in the US alone, multiple thousands of DA monitor points have, consistently, provided stable and repeatable field strength verification data for more that half a century. Accordingly we urge the reader to place statistically insignificant data point exceptions in their proper perspective relative to the universe of data that would be totally lost if monitor point measurements were eliminated from antenna array licensing requirements. In that vein, one must ask if computer generated antenna models should be presented for nominal conditions only, as they exist at the instant of modeling, or should there be a family of models that address "worst case" scenarios, as well? And, if so, what are those worst case scenarios? How do environmental changes affect the pattern(s) of the modeled arrays and, most importantly could they, or would they, introduce an unacceptable level of co-channel interference? We believe that retention of the requirements for field strength measurements, routinely recorded at designated monitor points, provides a time tested means for reconciling potential 'calculated vs. measured' issues by coupling truly verifiable data to the computer modeled array. To do otherwise, we believe, would be to lose a very valuable "handle" for monitoring and thus maintaining the horizontal patterns of a given AM Directional broadcast facility in each of its licensed operating modes.

In its Docket MB 03-151 Report and Order released May 25, 2007, the Commission established unambiguous criteria defining Directional antenna system operational tolerances; modified Section 73.62 to codify those limits, and set forth procedures for operation in the event tolerance limits are exceeded. Our reading of these Rules tells us that, in the event that relative phases exceed 3 degrees or the relative currents exceed 5%, as indicated by the facility antenna monitor, the licensee must measure and log every monitoring point at least once, each 24 Hr. period, for each directional pattern. Provided monitor point values are within specified limits, the station may continue operation for up to 30 days before a request for Special Temporary Authority must be filed. Further, in the event of a catastrophic failure of the array or the antenna monitor (phase indication tolerances in excess of 10 degrees or current ratio readings in excess of 15%), and absent contradictory monitor point data indicating that monitoring points are maintained continuously within their specified limits, the station is required to terminate operation, within three minutes, or to reduce power to a level sufficient to "eliminate any excessive radiation."

PI believes that these Rules, as adopted, are reasonable and provide adequate provisions for coping with actual day-to-day operational contingencies experienced by operators of AM Directional antenna arrays. Please note, however, that if the rules proposed by the Coalition were adopted, as presented, there would be no up-to-date monitor point data to refute erroneous antenna monitor indications in an antenna array that had been licensed under computer modeling

rules. Accordingly, an antenna monitor malfunction would, in and of itself, jeopardize the continued operation of the facility solely because of a lack of instrumentation redundancy. Our point here is: Correlation of antenna monitor data and continuously updated monitor point field strength data has proven, over a very long period of time, to be both an effective and reliable cross check for purposes of isolating operational problems from instrumentation problems in directional antenna array operations. We do not believe that the operational need for instrumentation redundancy is, in any way, circumvented through the use of computer array modeling.

Directional Antenna Arrays are more complex than single element non-directional antennas. It follows that the system failure rate for directional antenna arrays is also greater because of the increased number of components, connections, switches, and complexity of the ground grid. Electrical component failures are characterized by relatively high rates early in life and at the end of life with a long intervening period of low random failure rates. The plot of failure rate versus time is often referred to as the "bathtub curve." Since most of the directional antenna arrays in the U.S. have been in existence for years, it is safe to assume that the components in the networks connecting the transmitter to the various antenna elements are at various stages of useful life. Accordingly, we submit that the basic premise that Directional Antennas "be properly designed, constructed, tested, monitored and maintained," as stated in the opening the inquiry of 1993, is as important today as it was when the NOI was written. And yet, a number of the more difficult technical issues raised by the NOI are either ignored or lack specificity in the current proposals before the Commission. With emphasis on the monitoring aspects of maintaining an array we have repeated some of the NOI's more vexing questions and have offered specific suggestions in a Q&A format below:

Q. *"What types of instrumentation are appropriate at the AM broadcast station for measuring antenna operating parameters? Where, physically and electrically, should this instrumentation be placed?"*
A. The Coalition proposed rules place the entire monitoring burden on the antenna monitor with no requirements for backup or other measurement redundancy in the event of device failure. Lightning does strike towers in directional antenna arrays. In some parts of the country it strikes with some regularity. Even though antenna monitor manufacturers have made great strides in hardware lightning protection at the sampling line and power line inputs, lightning does not always follow a predictable path. Absent array monitoring redundancy, it is impossible to know if the antenna monitor, the array, or both, were damaged by the lightning strike. Lightning damage is merely one of the, more spectacular, external sources of antenna monitor indication error. Also, we should point out that a large part of the existing antenna monitor fleet harks back to 1973 and 1974 and some of those monitors have, to our knowledge, never been re-calibrated.

Field Strength, at FCC designated monitor points, should be measured periodically and permanently recorded in station maintenance logs to provide array instrumentation redundancy and field strength trending information.

Antenna monitors should be fed by FCC "Approved Sampling Systems." Field Strength readings should be gathered at specified intervals at FCC designated (monitor point) locations.

Q. *"Within what bounds of variation should parameters be maintained?"*
A. Antenna Monitor:
Phase: ± 3.0 Degrees
Sample Current Ratio: ± 5.0%
Monitor Point Field Strength: ± 1.5 dB

Q. *"What instrumentation error tolerance is acceptable?"*
A. Antenna Monitor (within manufacturer's specified range):
Phase: ± 1.0 Degree
Sample Current Ratio: ± 1.0%
Field Strength Meter (within manufacturer's specified range): ± 0.5 dB

Q. *"How frequently should the instrumentation readings be examined?"*
A. Once per week, for each pattern, unless Antenna Monitor readings are continuously and automatically logged.

Q. *"How frequently should the instrumentation itself be calibrated, and to what standard?"*
A. Antenna Monitors: Biennially, within 30 days of the initial computer modeled antenna verification date or subsequent computer modeled recertification dates. Or, more frequently, as dictated by anomalous indications that cannot be confirmed by alternate array monitoring techniques.

Field Strength Meters: Triennially, or more frequently, as dictated by anomalous indications that cannot be confirmed by alternate array monitoring techniques.

Antenna Monitors and Field Strength Meters should be calibrated either by the original equipment manufacturer or by an independent calibration laboratory that maintains traceable reference standards sufficient to certify that the device complies with the equipment manufacturer's original published specifications.

Q. *"What type and extent of documentation of instrument readings should be generated and maintained? What information should be submitted to the Commission, and in what time frame(s)?"*
A. These questions were addressed by the Commission in the May 25, 2007 ruling in MB Docket No. 03-151. But, as a matter of good engineering practice, we would recommend that Antenna Monitor and Monitor Point Field Strength readings be recorded in the station maintenance log once per week for each antenna pattern. In a fashion similar to that of tracking the gas mileage of an automobile, a continuous log of antenna parameters can indicate that a "tune up" is in order.

We understand that the existence of such logs could also be viewed as a source of self indictment, by the licensee, in the event that it were used as evidence of a willful violation if the array was determined to be operating beyond legal tolerance. Accordingly, absent specific rules requiring logs, we doubt that few stations would opt to maintain such logs regardless of their technical value.

Q. *"What routine should be followed in taking measurements in the field?"*
A. 47 C.F.R. § 73.61, as amended, serves as a bare minimum standard for monitor point measurements.

Q. *"What parameters should be measured?"*
A. Monitor Point Field Strength.

Q. *"What instrumentation is appropriate?"*
A. A calibrated Field Strength Meter that has been designed for the purpose or a calibrated tuned voltmeter and calibrated MW antenna with appropriate, traceable standards, and documentation to enable the user to apply the appropriate mathematical correction factors to the data obtained.

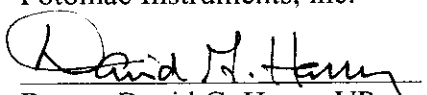
Q. *"At what distances should readings be taken?"*
A. At the monitoring point locations specified in the instrument of authorization.

Q. *"What should be the criteria for selecting sites for field measurements?"*
A. We believe that existing monitor points should be retained where feasible. If an existing monitor point becomes inaccessible or has become otherwise unsuitable since the last full proof we believe that a new point should be established on the same radial and from existing data where possible. We believe that the requirements for GPS coordinates and measurement site photographs should be retained.

Q. *"To what degree should there be repeatability for readings from the same site?"*
A. A review of previous comments on this subject by both broadcasters and consulting engineers indicates that the readings should be held to a tolerance of between 10% and 20%. We have recommended a tolerance of 1.5 dB or 18.9%.

In summary, **PI** believes that the advent of field proven MoM modeling is a major technological advancement for MW transmitting directional antenna arrays and we believe that its use should be fostered to the extent that it proves to be of benefit to the licensee, the regulatory agency, and the standard broadcast listening public. We also remind the reader that neither antenna arrays nor antenna monitors are static devices and that each requires continuous monitoring and periodic maintenance. So, in the euphoria of the moment of embracing this new computational tool, we urge the Commission not be stampeded into loosing perspective of the significance of monitor point field strength measurements in the directional antenna system monitoring process.

Respectfully submitted,
Potomac Instruments, inc.



By: David G. Harry, VP